

Please upload a neatly edited PDF with your answers to the three problems below. Please show all your working out—we are interested in seeing how you think about and approach these kinds of problems. We are not interested in answers you found online.

Question 1

Compute the determinant of A^{50} , where A is the matrix

$$A = \begin{pmatrix} 1 & 7 \\ 7 & 1 \end{pmatrix}.$$

Question 2

Imagine we are simulating a system containing a number of particles constrained to move along a 1D line of length N cm. Each particle moves in a particular direction (left or right) with a constant speed of 1 cm/s. When a particle reaches either end of the line, it is immediately removed from the system. If two particles meet at the same point, they both turn around (i.e. reverse their directions) and begin moving in the opposite directions. At the start of the simulation, we know the original positions of the particles on the line, but we do not know the direction they are facing! Given only the starting positions, write a program that will compute the earliest and the latest possible times needed for all particles to be removed from the system, given that every particle can be facing either left or right to begin with.

Your program should accept the following input. The first input is a single integer N , the length of the pole. The next is an integer K , specifying the number of particles. K integers follow, where each integer specifies the starting location of a particle.

Your program should then output a) the earliest possible time when all the particles fall off the pole, and b) the latest possible such time.

Sample input: 214 7 11 12 7 13 176 23 191

Sample output: 38 207

Question 3

You have trained a convolutional neural network on chest x-rays to classify if a patient is healthy, or has one of three conditions that are difficult to diagnose. The accuracy on training data is 99.8%, and the accuracy on test data is 97.3%. The confusion matrix of the test results is:

		Predicted			
		Normal	Condition 1	Condition 2	Condition 3
Actual	Normal	13727	8	5	4
	Condition 1	121	16	5	1
	Condition 2	97	3	7	17
	Condition 3	103	2	14	12

On finding the above results, you now need to report on the model to your supervisor. You need to convey if you feel it is a good or a bad model, and precisely why you have arrived at this conclusion. Convince your supervisor of this point.
